

ESTIMATION OF EVAPORATION RATES FOR RIPARIAN VEGETATION

L.E. Hipps ^{1*}, D. Cooper ², W. Eichinger ³

¹ Utah State University, Logan, UT

² Los Alamos National Laboratory, Los Alamos, NM

³ University of Iowa, Iowa City, IA

1. INTRODUCTION

In studies of the evaporation of riparian zones, the most critical aspect is the evaporation of the woodland corridor. However, the narrow and heterogeneous nature of this corridor creates serious difficulties for quantifying the short-term fluxes of water vapor.

Here we describe the critical processes governing evaporation in such an ecosystem in the SALSA study, and indicate the problems in application of standard approaches. Then we suggest an approach which is suitable to calculate evaporation rates for this site.

2. THEORETICAL CONSIDERATIONS

At the SALSA study site, upland vegetation occurs in reasonably well-defined patches of dimensions of several hundred meters. However, the woodland corridor is a narrow zone of trees 50 to 70 m wide and over 20 m tall, distributed rather heterogeneously, with some sizable gaps in the zone.

Note that short-term evaporation rates for local regions of a landscape are best done using various micrometeorological approaches. However, these approaches assume the surface is horizontally uniform, and extensive enough so that a boundary layer can develop which is fully adjusted to the surface.

This is essentially a very narrow, rough, and spatially variable surface. The major problems in a direct application of usual techniques are as follows:

1. The tall nature of the trees makes it difficult to get reliable measurements above the

community.

2. The boundary layer above this surface will likely only partially develop. Only a variable roughness sublayer will be likely to form.
3. The narrow dimensions - the width is only about twice the height - and presence of significant gaps in the zone, may result in significant lateral fluxes of water vapor.
4. The actively transpiring zone lies in an arid landscape, resulting in a strong situation of horizontal advection of heat and saturation deficit.

Figure 1 illustrates our concept of the interactions between the woodland corridor and

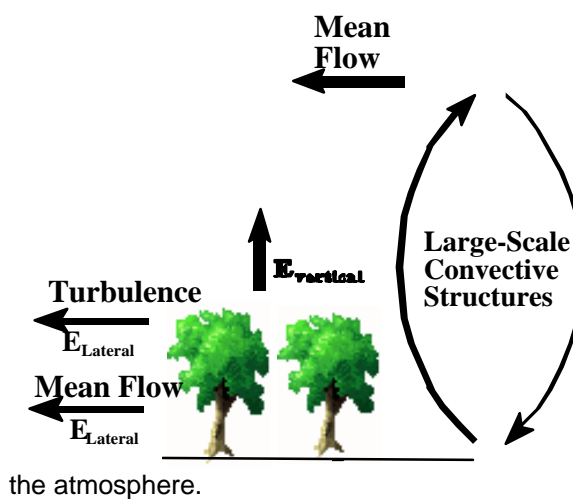


Figure 1. Conceptual view of water vapor fluxes from woodland corridor.

Clearly direct application of eddy covariance or Bowen Ratio approaches are not feasible. Another approach must be determined. Note that as air moves past the zone, a control volume is defined by the region of air which receives water

* Corresponding author address: Lawrence Hipps, Plants, Soils, & Biometeorology, Utah State University, Logan, UT 84322-4820;
E-mail: Larry@claret.agsci.usu.edu

vapor from the evaporation. The difference in the lateral flux of water vapor between the upwind and downwind sides of the zone, will yield the evaporation rate of the zone. Such an approach was successfully used by Hipps and Zehr (1995). It involves determining vertical profiles of wind and humidity at upwind and downwind sides of the volume.

3. METHODS

The study was conducted as part of the SALSA Experiment. The measurements were made at the Lewis Springs study site. Temperature, humidity, wind speed and direction were measured at a 10 m tower described in Scott et al., this issue. Winds above 30 m were determined with a Sodar system. Occasional vertical profiles of temperature, humidity, wind direction, and wind speed were determined near the corridor using a tethered balloon system.

A Raman Lidar system described by Cooper et al., this issue deployed at the site. This system measures the spatial distribution of water vapor.

We will look for periods when the wind directions was perpendicular to the woodland zone, and all necessary measurements were available. The Lidar will yield the vertical profiles of water vapor. When combined with other humidity and wind measurements, the evaporation rate could be estimated.

4. REFERENCES

Hipps, L.E. and D.F. Zehr. 1995. Determination of evaporation from integrated profiles of humidity and temperature over an inhomogeneous surface. *Boundary Layer Meteorology*, 75: 287-299.

REFERENCES IN THIS ISSUE

Cooper, D.I., W. Eichinger and L. Hipps, Spatial properties of water vapor scalar and flux over a riparian corridor.

Scott, R., J. Shuttleworth and D. Goodrich, Water use of two dominant riparian vegetation communities in southeastern Arizona.